

Radiation Shield Optimizer using Genetic Algorithms

Completed Technology Project (2014 - 2015)



Project Introduction

The harmful effects of radiation are one of the most significant challenges to long duration spaceflight. Therefore, we aim to develop a new approach for optimizing radiation shielding materials systems. In particular, we are looking at providing a tool to optimize how materials layers are sequenced in order to enhance radiation shielding as well as to mitigate the effects of secondary radiation. There are two broad scenarios where layering of materials is required in spacecraft and can have an impact on the radiation environment crew and equipment experience, (1) where the layers are deliberately put in sequence for the best shielding; (2) when materials are required to be in place to serve other functions such as electrical conductors, logistics etc. With the new tool we want to be able to, in both cases, determine the optimum arrangement of these materials for shielding and dynamically so, in the case of logistics. Success in providing the best possible radiation shielding means missions can run longer and safer by getting exposure as low as is reasonably achievable (ALARA). Currently, while there are a number of tools that calculate radiation transport (how radiation propagates through a materials system or spacecraft structure), there has been little work looking specifically at how to get the most benefits from sequencing layers of materials and particularly how to do so in a way that is adaptable to the radiation environment that is to be encountered. Typically, a few materials layers that the designer has an intuitive feel might work best are tested (using the transport codes) and the best of those adopted. There is not an exhaustive search of the solution space for the best possible materials configurations. The present approach combines robust physics based tools for radiation transport in materials, with an effective strategy for sifting through a large range of possible shielding layer configurations efficiently. Mimicking the process of natural selection, allows a more thorough search of the space of possible shielding layer configurations by speeding up convergence to effective solutions in an economical (time and computer resources) way. This is particularly important for dynamic solutions such as when considering changing amounts of logistics supplies being used in a radiation shielding application or changing radiation environments. Genetic Algorithms also allow for the discovery of hitherto unexpected, non-conventional and non-intuitive shielding layer configurations.

Anticipated Benefits

N/A



Radiation Shield Optimizer using Genetic Algorithms

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

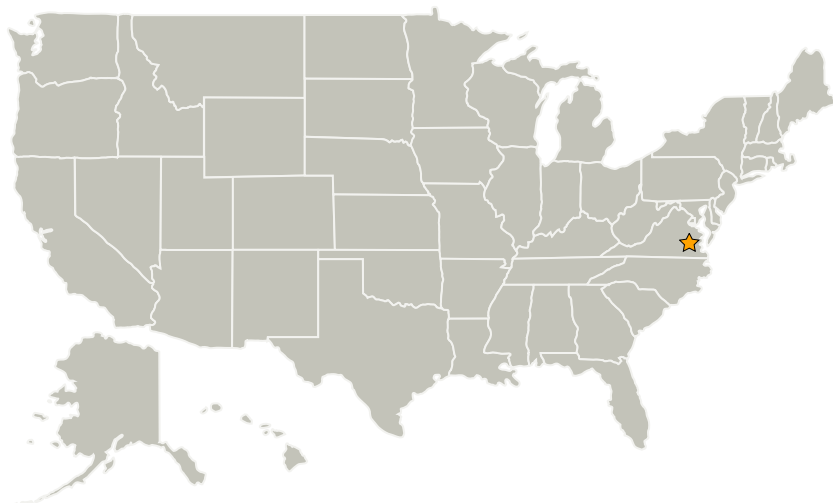
Center Innovation Fund: LaRC CIF

Radiation Shield Optimizer using Genetic Algorithms

Completed Technology Project (2014 - 2015)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Langley Research Center (LaRC)	Lead Organization	NASA Center	Hampton, Virginia

Co-Funding Partners	Type	Location
Analytical Services & Materials, Inc.	Industry Small Disadvantaged Business (SDB), Women-Owned Small Business (WOSB)	Hampton, Virginia
National Institute of Aerospace	Academia	Hampton, Virginia

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Julie A Williams-byrd

Project Manager:

Sandra P Walker

Principal Investigator:

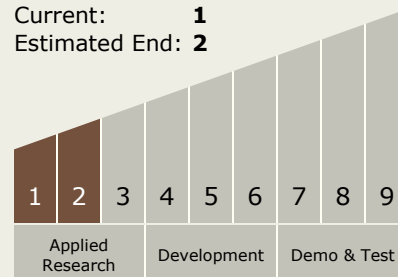
Godfrey Sauti

Co-Investigator:

Sheila A Thibeault

Technology Maturity (TRL)

Start: **1**
 Current: **1**
 Estimated End: **2**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - TX06.5 Radiation
 - TX06.5.3 Protection Systems